Term Project Checkpoint C

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Introduction

The consistent goal of this project throughout the checkpoint pipeline has been to provide investors with positive returns on what we consider to be relatively safe investments. In the previous checkpoint, the Vanguard Total Stock Market (VTI) ETF was incorporated into the fund to help diversify the portfolio. That remains for this checkpoint, however, an additional ETF – QQQ, which tracks the Nasdaq 100 index – has been included in the portfolio as well. Until now, the fund was considering extremely risk-averse investors as clients. In the last checkpoint, we compared our portfolio to the QQQ as a benchmark for performance given the historical period of our data. Despite being able to achieve decent returns on a moderately low level of risk, we feel as a fund that the gap between the QQQ market performance and our portfolio was too large. We are now pivoting to a slightly less risk-averse investment strategy. This is why QQQ is going to be included in the fund, as we believe the high-growth asset will help our clients gain the excess returns they're looking for, while being accepting of a higher level of risk.

Ultimately, the fund will still be employing Clenow's momentum strategy with monthly rebalancing seen in Programming Assignment 3 (), using a different minimum threshold value in order to coincide with our "looser" approach to investing. The strict buy-and-hold strategy without any rules for entry and exit from the market is no longer considered a viable approach for investing.

Literature Review

In Checkpoint A, professors Rohnn Sanderson and Nancy L. Lumpkin-Sowers and their experiment testing buy-and-hold strategies with ETFs was identified as an inspiration for this project. That remains to be the case, as their conclusions – along with testing from previous experiments – has caused our pivot in strategy.

Sanderson and Lumpkin-Sowers point out that a buy-and-hold strategy given the current volatile nature of the stock market is obsolete because average modern investors are less likely to hold for the length of time necessary to be profitable, especially during the downs of today's market (2018). Note, this

study was done even before the COVID-19 Pandemic, which makes it all the more likely that an investor is going to be wary of holding onto their assets through a downturn of such a magnitude.

Their research on ETFs also inspired which exact assets we've chosen to include in our portfolio. The professors write that "When an ETF fails, it quietly disappears from the marketplace, and clients' funds are generally rolled into something else. This means that there are only a handful that stay around over the long haul and the results of those remaining look pretty good" (Sanderson and Lumpkin-Sowers, 2018). We have 20 years of solid historical data for our ETFs, giving us confidence that SPY, TLT, VTI, and QQQ are healthy and stable funds to include into the portfolio given Sanderson and Lumpkin-Sowers' observation.

Methods

At this point in the project we are building on previous experiments to continue to refine our trading strategy. However, there were new experiments performed in Checkpoint C compared to previous work. The first is to examine our baseline portfolio strategy statistics, and see how it compares using the S&P 500 index (SPX) as a benchmark. This primarily includes stats such as the Sharpe Ratio, max drawdown, and average annual returns, or alpha. This gives us the baseline for our altered portfolio and revised strategy to compare going forward.

The second experiment actually adds the QQQ historical data into the portfolio to be used as an asset. Then, the Clenow momentum strategy seen in Assignment 3 is performed again but with a lower minimum momentum threshold identified in the Introduction. For this experiment, a momentum value of 0.0001 was chosen, less than the 0.0005 used in past experiments. This aligns with our goal of "loosening" up our strategy to try and maximize returns, willing to take on additional risk. After this is set-up in the strategy parameters the experiment will be run and then we will examine the statistics against the S&P 500 and our baseline strategy.

The third experiment introduces Monte Carlo methods to add randomness and simulate a possible distribution of outcomes for our portfolio. This can be valuable information for investors to get

an idea of what their investment might accrue. The final experiment is mainly intended to provide a sneak peak at the final checkpoint and project deliverable. As a fund, we will have to establish a fee structure for our management services. This simple example used alpha, or average annual returns, for our portfolio and if we were to perform above expectations then we would take a 10% cut. If the annual returns dipped below our alpha level then that fee would be reduced to 3%. These were arbitrary percentages used as a baseline given the recommendations for the assignment.

Results

Prior to adding QQQ to potentially increase growth for our portfolio, we examined the metrics for the portfolio as it is, what we're calling baseline. The results show that base portfolio performance was as follows:

- Sharpe Ratio: 0.4503
- Max Drawdown: 0.0892
- Alpha: 0.0388 (3.8% annual return)

Our baseline portfolio with SPY, TLT, and VTI did not perform poorly necessarily. However, as mentioned in the Introduction, we are looking to increase the returns for our clients. Even if it means taking on potentially higher volatility.

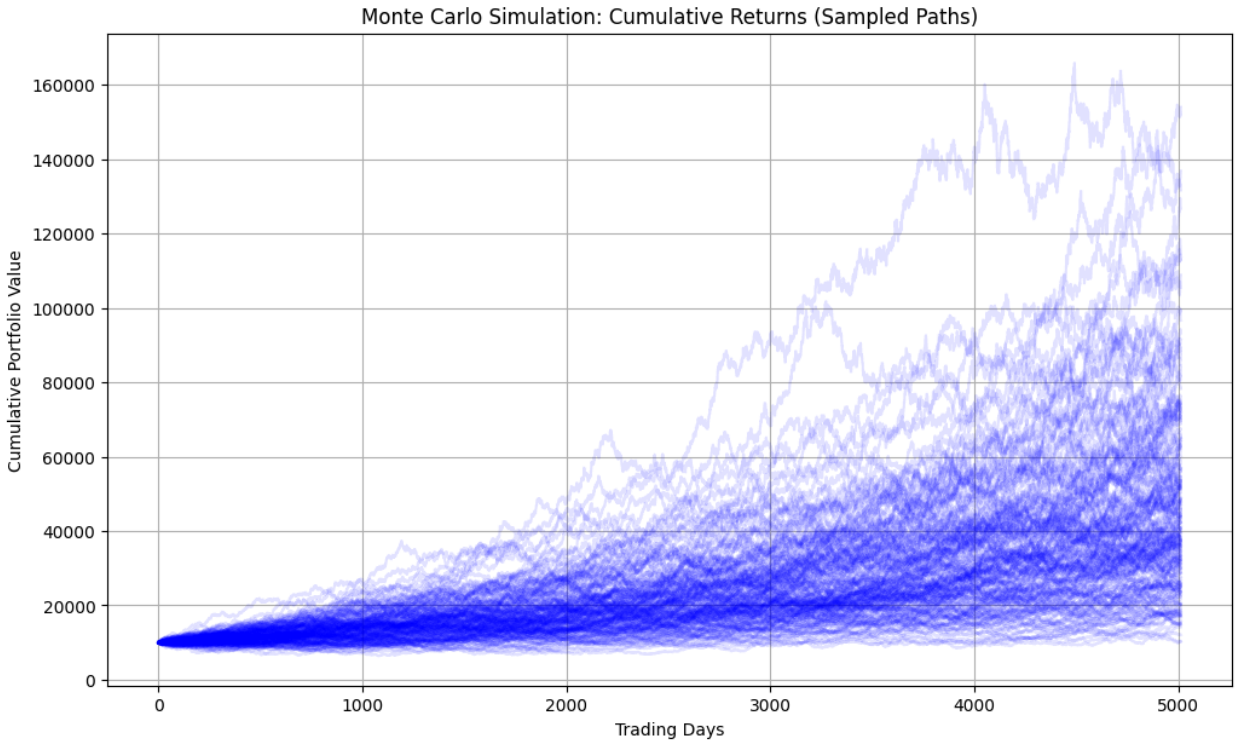
After incorporating the QQQ ETF into the portfolio, our metrics perform much better. The QQQ portfolio stats are:

- Sharpe Ratio: 0.5828
- Max Drawdown: 0.2011
- Alpha: 0.0703 (7% annual return)

As you can see, once QQQ is added, we see an increase in every metric. This supports our initial belief that QQQ could be a potentially high-growth asset based on what we saw in Assignment 3's benchmark test. We do indeed see both increased volatility and an increase in our maximum drawdown. This means a higher peak-to-trough for our portfolio in periods of market downturn, exposing us to even greater risk.

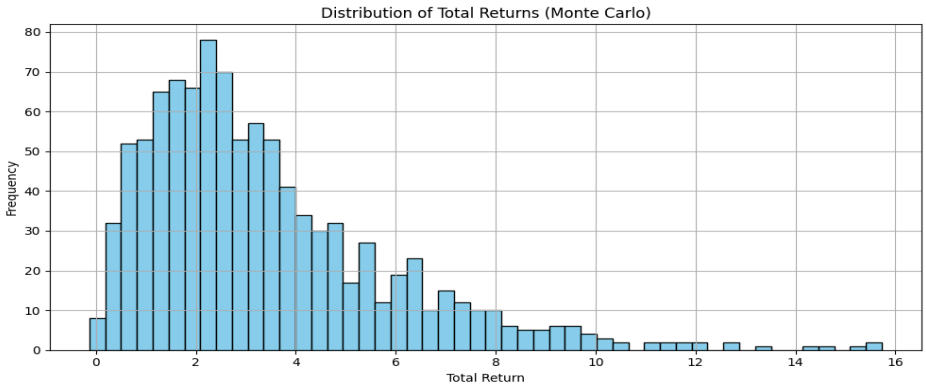
However, in an adjustment to our initial philosophy we are allowing ourselves to face greater risk if it means higher returns. The optimal amount of risk will be explored in the final deliverable.

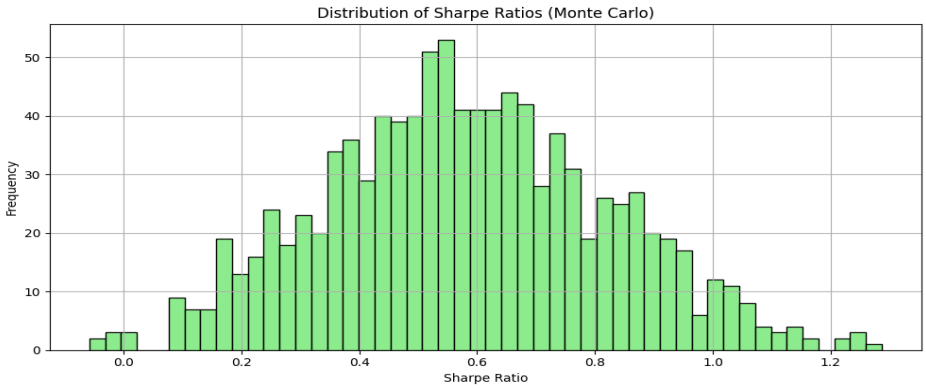
The Monte Carlo results gave us a series of possible distributions for our portfolio's performance:

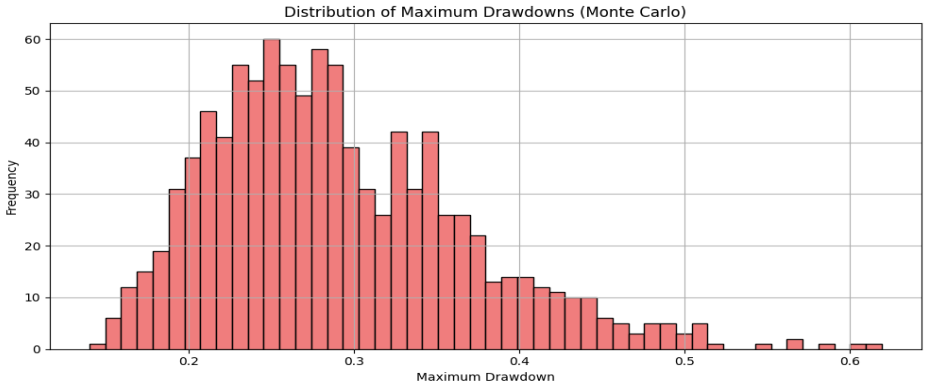


This path plot shows the various possible growth paths for our portfolio. The lines in lighter shades of blue are the outliers, for example the path at the top which showed extreme growth is not likely to happen many times in the 1000 simulations run. However, the darker paths are where we get close to the average performances.

The plots below show distributions for the major metrics we have been examining: returns, Sharpe Ratios, and max drawdowns. The Monte Carlo simulation of our portfolio makes sense when comparing it with the growth paths plot. The frequency of portfolios generating excessive returns declines as the return percentage increases. This means there are far fewer instances of extreme growth for our portfolio and most of the portfolios' average return is going to fall around the same range.







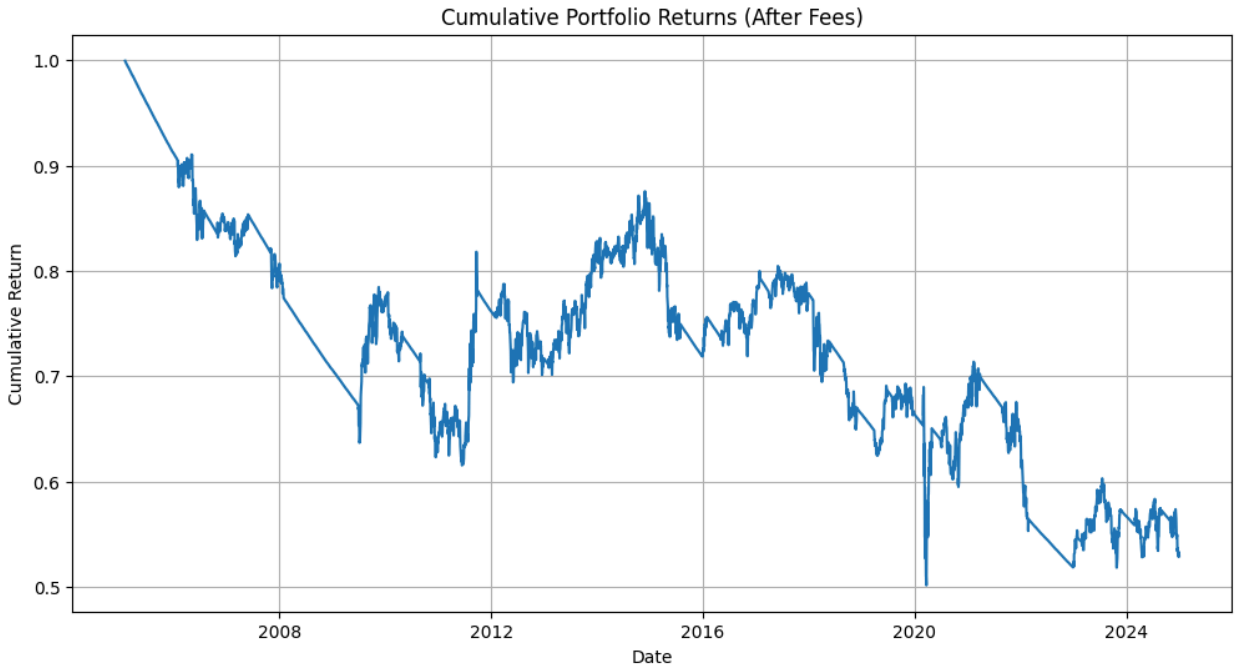
The Sharpe Ratio distribution tells us that we can expect to see healthy efficiency within our portfolio. That is, the return on investment given the risk. We see a fairly solid bell curve shape to our plot, which gives us a sense of consistency of the types of Sharpe Ratios we are likely to see.

The max drawdown plot being similar to the total returns is a plus in our opinion. In the way we won't see excessive returns, we are unlikely to see excessive losses either. This is good news to potential clients seeing that there is a much lower frequency we are going to see steep declines in value for our portfolio during bad times.

The final experiment was introducing fees into the equation. The base structure of the fees is outlined above in the Methods section. The results of implementing fees on our returns is as follows:

- Sharpe Ratio: -0.2605
- Max Drawdown: 0.4983
- Alpha: -0.0314 (3.1% loss)

Along with the graph:



The introduction of investment and management fees into our portfolio did not go well. However, we must clearly establish some sort of pay structure for our fund to run. The results of this experiment is more of a precursor to the optimal fee structure that will be used in the final deliverable for our clients portfolio to still see positive returns.

Conclusions

Future work largely focuses on optimization, and clearly defining both our fee structure and the optimal metrics for generating the best returns for a reasonable amount of risk. In the Introduction it was stated that we are now accepting more risk if it means higher returns. However, we must clearly establish

the risk level given our clients initial investments. Work will be done to identify the optimal Sharpe Ratio that tells us the efficiency of our portfolio given the risk associated with our investments.

References

Sanderson, Rohnn, and Nancy Lumpkin-Sowers. “Buy and Hold in the New Age of Stock Market Volatility: A Story about ETFs.” *International Journal of Financial Studies*, vol. 6, no. 3, 6 Sept. 2018, p. 79, https://doi.org/10.3390/ijfs6030079. Accessed 13 Oct. 2025.